Appendix 7B-2: Draft CERP Annual Report Card

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INTRODUCTION

The *2001 CERP Annual Report Card* reports on the status of 14 key indicators of the effects of the CERP on the "health" of the South Florida environment. The 2001 report card is the first annual report card for the initial elements of the CERP, authorized by the Water Resources Development Act of 2000, and Sections 373.026 and 373.1501 of the Florida Statutes. Now in the earliest stages of implementation, it is not expected that the CERP can yet show positive affects on the indicators of the health of the Everglades basin. Thus the grades reported in this report card are indicative of baseline or pre-CERP conditions rather than of any improvements brought about by the implementation of the CERP.

A major reason for issuing a report card for 2001, which is so early in the implementation of the CERP that system responses are not yet possible, is to assure the public that we will be regularly reporting on the progress made towards meeting the restoration goals of the CERP. It is important at this early stage to familiarize the public with the key indicators that are proposed to be used for this purpose, and to prompt public review and comment on the content and organization of this reporting document. An early objective of the report card is to make improvements in its content and organization in response to public reviews.

WHAT IS A REPORT CARD?

A report card is a means of briefly and periodically summarizing and updating the progress being made towards some goal or objective. A report card compares the recent or current status of one or more "indicators" with the status of these same indicators during earlier time periods, and with interim and final goals that have been set for each of the indicators. A report card provides a "grade" of each indicator as a basis for making comparisons among indicators and time periods, and for providing either a quantitative (i.e., numerical) or qualitative (e.g., colors or symbols) measure of how well each indicator is reaching its interim and final goal(s). Report cards should report on a consistent set of indicators over time, thus standardizing the measures used to assess the progress being made towards one or more goals. Report cards are usually issued at regular and predictable intervals of time.

Report cards have been used in regional ecosystem restoration and protection programs in many areas of North America. Often these report cards have been designed in multiple formats, in order to inform a range of audiences. Commonly the intended audiences include the interested

public, stakeholders, managers, policymakers, legislators, and other funding sources. In most locations, regularly issued report cards have become the primary means of keeping the intended audience informed on the progress of an environmental program.

THE CERP ANNUAL REPORT CARD

The Comprehensive Everglades Restoration Plan (CERP) has been designed for the ecological restoration of the greater Everglades basin and to meet water supply and flood protection needs in the urban and agricultural regions of South Florida. The magnitude of the restoration program and the political and financial commitment that will be needed to see it through to completion require that the people of Florida, the nation, and the world be regularly informed on the progress being made towards the plans interim and final goals. To provide this measure of progress, a CERP Annual Report Card will be issued throughout the period of implementation of the CERP.

The objectives of the CERP Annual Report Card are to describe how the natural and human systems are responding to the influences of the CERP, and to explain why the observed responses are occurring. To meet these objectives, the report card will use a set of "key indicators" of environmental health for both natural and human systems in South Florida as a way of informing the public and decision makers on the success of the plan.

The CERP Annual Report Card will provide an annual grade for each of the key indicators. The range of grades for the full set of key indicators is intended to be representative of the success that the CERP is having in meeting its goals. These grades will be based on assessments of the status of each of the indicators each year during the implementation of the CERP. For most key indicators, one or more interim goals will be developed, in addition to the final goal(s). These interim goals will show the levels of improvement that are expected at appropriate intervals during the implementation of the plan. These interim goals will be added to the report card during the next one to two years.

The creation and production of the CERP Annual Report Card is a programmatic activity of the CERP, meaning that the CERP Annual Report Card will be used to show progress throughout the full duration of the implementation of the plan. The RECOVER Leadership Group has the lead responsibility for designing and issuing the initial CERP Annual Report Card.

The CERP Annual Report Card is designed for multiple audiences, including the interested public, stakeholders, and the decision makers who will be guiding the implementation of the plan. To be most effective with this array of audiences, it is planned that the CERP Annual Report Card will eventually be issued in multiple formats designed to provide different levels of detail that are appropriate to specific audiences.

The CERP Annual Report Card will be issued annually. The initial draft was created through a series of technical and public workshops during 2001. This version will go through public review late in 2001, and will become the basis for the first CERP Annual Report Card in 2002.

Implementation of the CERP is scheduled to occur over a 35-year time period beginning in 2001. Positive responses by the key indicators in both the natural and human systems will only occur as major water storage and delivery features of the CERP are completed, and as ecological conditions have had adequate time to adjust to the hydrological and physical changes brought about by the CERP. For this reason, early editions of the CERP Annual Report Card will show little in the way of improvements. Nevertheless, it is important that CERP begin to issue an

annual report card from the beginning, to help everyone become familiar with the indicators being used to report CERP progress, and to elicit comments that can lead to improvements in the information provided in future report cards.

HOW THE CERP ANNUAL REPORT CARD HAS BEEN CREATED

The basic component of the CERP Annual Report Card is a set of "key indicators". The key indicators proposed for the report card have been selected from a much larger number of technical performance measures contained in the Draft CERP Monitoring and Assessment Plan. Collectively, the key indicators show how the natural and human systems are responding to the changes brought about by the CERP. The specific criteria that were used for selecting the proposed key indicators were that each must 1) measure an element of the natural or human systems that the CERP is expected to improve, 2) be representative of the overall health of all or a portion of the regional system and of the goals of the CERP, 3) be an element of the regional system that is both important and relevant to the public and decision makers, 4) have a measure of baseline conditions (pre-CERP) as a means of tracking the responses brought about by CERP, and (5) be well enough understood in the context of the natural and human systems in South Florida for the monitoring results to be interpretable.

The initial CERP Annual Report Card has evolved from a *Base Line Report for the Comprehensive Everglades Restoration Plan 1999* (RECOVER, 2000) issued by the RECOVER Leadership Group in 2000. The baseline report was issued to illustrate the proposed purpose and organization for the CERP Annual Report Card. The baseline report described the status and provided a grade for ten key indicators of the environmental health of South Florida. The grades for the key indicators in the baseline report were for pre-CERP conditions, and as such, showed the starting point level of health for the natural and human systems.

A two-day technical workshop was held on April 2 and 3, 2001, to review the key indicators contained in the baseline report, and to propose additional key indicators that would improve balance in reporting progress towards the restoration goals of the CERP. The review of the original set of key indicators and selection of additional indicators were accomplished by a two-step process during the workshop. These steps were 1) create a list of potential key indicators that would be useful for reporting the success of the CERP in meeting its stated goals, and 2) for all participants in the workshop to vote on the potential indicators on the list to identify the priority indicators. The resulting list contained 18 proposed key indicators:

1. Average annual concentration of phosphorus and nitrogen systemwide
2. Everglades tree island/healthy salinity ranges
3. Suite of indicator fishes (spotted trout for Florida Bay; large-mouth bass for Lake Okeechobee)
4. Recreational/commercial fishing rates/success
5. Total system wood stork nesting patterns
6. Total system American alligator numbers/patterns
7. Total system wading bird nesting patterns
8. Select "listed" species health
9. Extent of submerged aquatic vegetation in Lake Okeechobee and estuaries

10. Meeting urban and agricultural water needs; 1-in-10 year drought requirements
11. Reestablish Natural System Model (NSM) hydropatterns/remove sheetflow barriers
12. Pink shrimp catch rates in Florida Bay, Biscayne Bay, and the Tortugas
13. Increase total extent of healthy wetlands
14. Thousands of acre-feet of fresh water captured/stored
15. Increase the extent of healthy oyster beds in the St. Lucie and Caloosahatchee Estuaries
16. Florida Bay and Gulf Coast roseate spoonbill recovery
17. Impacts of flows to estuaries (crocodile, snail kite, etc.)
18. Reductions in invasive/exotic species

The current draft of the CERP Annual Report Card contains a restructuring and synthesis of these 18 proposed indicators into 14 key indicator reports. The 14 indicators are as follows:

1. Total area of healthy oyster beds in St. Lucie Estuary
2. Flow patterns (volume and timing) as a measure of the health of the Caloosahatchee Estuary
3. Total phosphorus concentrations in Lake Okeechobee
4. Submerged aquatic vegetation in Lake Okeechobee
5. Health of aquatic animal communities in the interior Everglades ridge and slough system
6. Everglades tree islands recovery
7. Number of stable subpopulations of the Cape Sable seaside sparrow in the Everglades marl prairies
8. Roseate spoonbill nesting patterns in the Southern Mangrove and Florida Bay Estuaries
9. Seagrass beds and shrimp health in Florida Bay
10. Wading bird nesting patterns for the total system
11. American alligator distribution and abundance in wetland communities throughout the total system
12. Spatial extent of healthy freshwater wetlands throughout the total system
13. Phosphorus effects on natural wetlands throughout the total system
14. Water supply for South Florida

ORGANIZATION OF THE CERP ANNUAL REPORT CARD

The format of the key indicator reports in the CERP Annual Report Card is a modified version of the format originally used in the *1999 CERP Baseline Report* (SFWMD, 2000). Each key indicator in the report card will provide information under five headings:

- **CERP Target -** a brief description of the restoration goal(s) and any interim goals for each indicator

- **Significance and Background -** the rationale for selecting the indicator as representative of the environmental health of a region or subregion of South Florida
- **Recent Status and Trends -** the current condition and historical pattern for the indicator in South Florida, and interpretation of causes of observed changes in the status of the indicators
- **Indicator Grade -** the current (annual) grade for the key indicator (red, yellow, or green)
- **Restoration Action -** actions implemented via the CERP during the preceding year that contribute to achieving the restoration goals for each indicator (e.g., lands purchased, construction initiated or completed, operational rules improved, etc.).

Other influences besides those produced by the CERP will be affecting the key indicators. These influences include short-term events such as hurricanes and other exceptional weather disturbances. Long-term events will also influence the success of the CERP. Long-term events may include the effects from sea level rise along our coasts, unpredicted changes in human population demographics, and the effects from unnatural patterns of fire and the stresses caused by exotic plants and animals. The role that these "outside" influences have on the success of the CERP will be assessed in the report card, as these influences become better recognized and understood.

GRADING SYSTEM

The red/yellow/green grading system used in this 2001 report card is a modified version of the grading system used in the *CERP 1999 Baseline Report* (SFWMD, 2000). In this 2001 report the grades indicate the following:

- Red - the status or condition of the indicator is degraded and unacceptable, or that it is changing in a direction that is moving away from the desired restoration target
- Yellow - the status or condition of the indicator is improving, but the level of improvement has not yet reached the desired restoration target
- Green - the status or condition of the indicator has reached the desired restoration target and this desired status is likely to be sustained

The remainder of this appendix consists of the indicator sheets for the 14 key indicators listed above. A figure will be provided in the final indicating the region that each indicator is located, as well as the indicator grade assigned to it.

Figure 7b-2-1. Location and Indicator Grade for the CERP Key Indicators.

TOTAL AREA OF HEALTHY OYSTER BEDS IN THE ST. LUCIE ESTUARY

CERP TARGET

The target of the CERP is to increase the total area of healthy oyster beds in the St. Lucie Estuary by approximately 4.5 times their current area. A healthy oyster population in the estuary is only possible if more stable salinity levels can be maintained. The target is based on both the implementation of the Indian River Lagoon Feasibility Study and the components of the Comprehensive Plan. The Indian River Lagoon Feasibility Study focuses on slowing down and cleaning up flows from the estuary's watershed. The Comprehensive Plan components deal with the undesirable flows from Lake Okeechobee to the estuary through the St. Lucie Canal (C-44). The target is also based on all areas of the estuary with a suitable bottom and potentially appropriate salinity ranges to support healthy oyster beds.

SIGNIFICANCE AND BACKGROUND

Development and modification of the St. Lucie Estuary watershed over the last 100 years has led to the degradation of the estuary by altering the quantity, quality and timing of freshwater entering the water body. Changes in the timing and volume of freshwater discharges can place severe stress on the entire ecosystem by changing natural salinity patterns. Also, large volumes of nutrient laden water along with warm temperatures and long day length during the summer season contribute to ecologically damaging algal blooms. The inability of the water body to take in this over abundance of algae is made worse by the decreased filtering of the water caused by the low numbers of healthy oysters and other bivalves.

The American oyster is an almost exclusively estuarine bivalve mollusk. It is ecologically important because it is a filter feeder, it is prey for numerous higher animals, and it makes habitat for other aquatic organisms. Because oysters cannot move around throughout most of their life cycle, they have adapted to a range of conditions. The range of salinity needed to sustain a healthy oyster population varies geographically and seasonally in the estuary. The salinity envelope is affected by alterations in the quantity, quality and timing of freshwater entering the estuary. Healthy oyster beds have been chosen as a key restoration indicator for the St. Lucie Estuary because a thriving oyster population indicates that the quantity and timing of freshwater flows into the estuary have been restored.

RECENT STATUS AND TRENDS

A field survey conducted in 1997 identified approximately 209 acres of oyster beds remaining in the St. Lucie Estuary. Large freshwater discharges from the watershed create stressful conditions for the remaining oysters on an almost annual basis. Regulatory releases from Lake Okeechobee that can turn the estuary into a virtually freshwater system and kill up to 90 percent of the remaining oyster beds in the midestuary did occur in 1998 and can reoccur on an average of every six to seven years.

INDICATOR GRADE

While no elements of the CERP that will restore the St. Lucie Estuary have been implemented, some increase in oyster population has been observed due to the fact that large regulatory releases from Lake Okeechobee to the estuary have not occurred since 1998. Dry conditions in the region have helped maintain a more favorable condition for the oyster population to increase. These increases have not been formally documented since monitoring has not been conducted since 1997. The oyster grade is red.

RESTORATION ACTION

A comprehensive program on oyster biology began in July 2002. This program will include laboratory and field work. The primary purpose of the program is to document detailed relationships of salinity, temperature and disease to oyster viability and reproductive potential. This information will be used to calibrate a model of oyster response to changes these variables.

Additional activities designed to restore the St. Lucie Estuary will begin following the completion of the Indian River Lagoon Feasibility Study. Over the past year, the Indian River Lagoon team has been finalizing the analysis, picking a preferred plan and completing the documentation of their work. The final report is scheduled to go to Congress for authorization under the WRDA 2002.

FLOW PATTERNS (VOLUME AND TIMING) AS A MEASURE OF THE HEALTH OF THE CALOOSAHATCHEE ESTUARY

COMPREHENSIVE PLAN TARGET

A more natural flow regime in the Caloosahatchee Estuary will be created by capturing Caloosahatchee River (C-43 basin) runoff and releases from Lake Okeechobee in basin storage and releasing it from storage as needed to meet estuary needs. Preliminary analysis suggests that a minimum (mean monthly) flow of 300 cubic feet per second (cfs) for *Vallisneria* is suitable to various types of estuarine biota found within the estuary, but mean monthly inflows greater than 2,500 to 3,000 cfs are detrimental to the community anytime of year (**Table 7b-2-1**). If the vast majority of flows range between 300 and 800 cfs, then the minimum discharge necessary to support *Vallisneria* will be attained. Since normal wet season mean monthly flows are usually greater than 300 cfs, meeting this inflow limit only needs to be considered during the dry season.

Table 7b-2-1. Summary of Recommended Flows through the S-79 Structure for Maintaining Ecological Health of Key Species within the Caloosahatchee River/Estuary System.[a]

Species	Low Flow Limit (cfs)	Preferred Inflow Range (cfs)	Upper Inflow Limit (cfs)	Important Months
Vallisneria	300	300 - 800	< 3,000	Dry season (November - May)
Halodule, *Thalassia*	---	---	3,000	
Fish (general)	300	300 - 1,300	3,000	Dry season
Larval fish	---	300 - 800	< 2,500	March-July
Fish eggs	---	150 - 600	< 2,500	All year
Pink shrimp and blue crabs	300	300 - 800	< 3,000	All year
Shrimp and crab larvae	---	<1,300	<2,500	All year (esp. Spring - July)
Benthic invertebrates (including oysters)	---	300-800	<3,000	All year

a. Source: Chamberlain and Doering, 1998

SIGNIFICANCE AND BACKGROUND

The Caloosahatchee Estuary is highly dependent on and sensitive to freshwater releases. Changes in the timing and volume of freshwater discharges can place severe stress on the entire ecosystem by changing natural salinity patterns. Salinity patterns affect productivity, population distribution, community composition, predator-prey interactions, and food web structure in the

inshore marine habitat. Therefore, maintenance of appropriate freshwater inflows is essential for a healthy estuarine system.

RECENT STATUS AND TRENDS

Currently, flows in the Caloosahatchee River and Estuary are controlled by regulation schedules for Lake Okeechobee and the S-79 structure. The overall ability of the schedules to meet demands and protect the resources is inadequate. Low flows are the primary concern, but during above normal rainfall years, high flow can also be a concern.

INDICATOR GRADE

No elements of the Comprehensive Plan designed to improve volume and timing of flows in the Caloosahatchee Estuary have been implemented and water storage in the basin remains inadequate. The grade for the flow patterns in the Caloosahatchee Estuary remains red.

RESTORATION ACTION

Minimum flows and levels (MFLs) have been developed to address low flows to the estuary. Criteria for MFLs were partially based on selected key indicators of a healthy estuarine system including submerged aquatic vegetation because it provides habitat for much of the estuarine community. The capability of the SFWMD to implement MFLs depends on the Comprehensive Plan's water storage components. Implementation of one of these projects, the C-43 Basin Storage Reservoir Project, is expected to produce a more natural delivery of flows to the estuary.

TOTAL PHOSPHORUS CONCENTRATIONS IN LAKE OKEECHOBEE

COMPREHENSIVE PLAN TARGET

One of the targets of the Comprehensive Plan is to achieve a long-term average open water concentration of total phosphorus of 40 parts per billion (ppb) in Lake Okeechobee. The Florida Department of Environmental Protection (FDEP) has adopted this as the goal for total phosphorus for the lake ecosystem.

SIGNIFICANCE AND BACKGROUND

Phosphorus is the nutrient element most often limiting to the growth of plants and algae in freshwater lakes. When phosphorus levels become excessive, dramatic changes in plants and animals can occur. These changes typically include increases in species that have undesirable impacts on habitat quality. An increase in the occurrence of noxious blue-green algae blooms (**Figure 7b-2-2a**) is an example. Based on scientific research done on the lake over the last decade, it is anticipated that reduced phosphorus concentrations in the lake will lead to fewer blooms of noxious algae, clearer water, increased submerged plants, and better conditions for sport fishing and other ecological and societal uses of the lake (**Figure 7b-2-2b**).

Figure 7b-2-2. Top: Noxious Algal Blooms in Lake Okeechobee Caused by High Total Phosphorus Concentrations and Bottom: Healthy Water.

RECENT STATUS AND TRENDS

Total phosphorus concentrations in Lake Okeechobee were near 40 to 50 ppb when first measured in the early 1970s (Figure 7b-2-3). These concentrations have increased over the last three decades and concentrations now average near 100 ppb in the lake's open water region. The increase is linked with increased amounts of external phosphorus coming into the lake over the long-term and with high water levels in shorter (year-to-year) time scales.

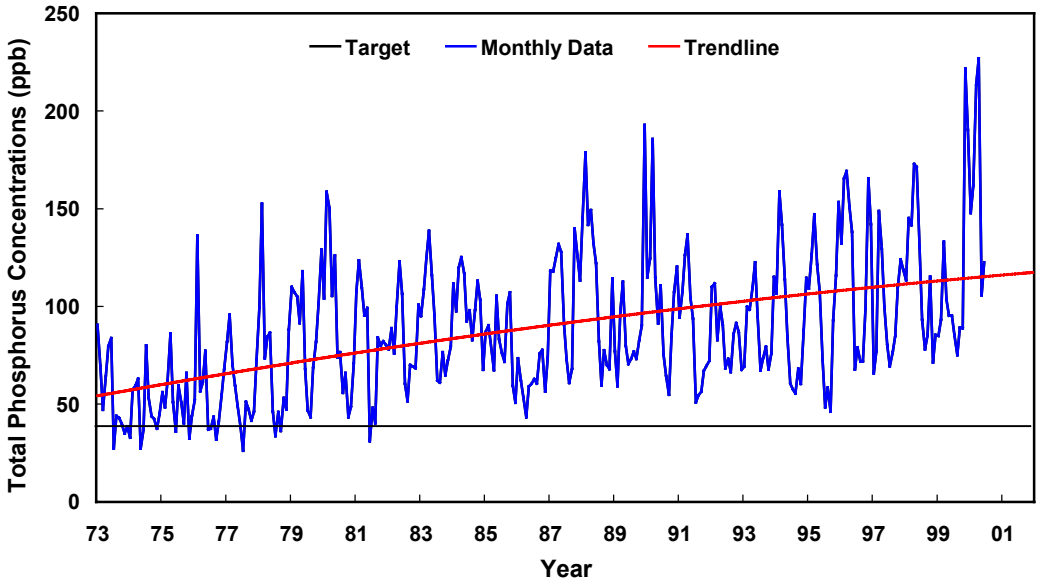


Figure 7b-2-3. Monthly Total Phosphorus Concentrations in Lake Okeechobee from 1973 to 2001.

INDICATOR GRADE

The current grade is red indicating that the performance measure is far from meeting the established restoration goal and that the ecosystem is being impacted as a result.

RESTORATION ACTION

Lands have been acquired for the Lake Okeechobee Critical Project for isolated wetland restoration and pilot stormwater treatment areas (STAs). Project design is proceeding.

SUBMERGED AQUATIC VEGETATION IN LAKE OKEECHOBEE

RESTORATION TARGET

One of the restoration targets within Lake Okeechobee is to sustain at least 40,000 total acres of submerged aquatic vegetation around the northern, western, and southern shoreline of the lake, with at least 20,000 acres contributed by vascular plants (in particular eelgrass and peppergrass).

SIGNIFICANCE AND BACKGROUND

In shallow eutrophic lakes, the submerged vegetation plays a critical role in stabilizing sediments, supporting attached algae that removes phosphorus from the water, and providing critical habitat for fish, wading birds, and other wildlife. Vascular plants provide the most valuable habitat, while *Chara*, a macro alga that is common in this and other shallow eutrophic lakes, serves to stabilize sediments, but is not as useful for wildlife. Shoreline areas of Lake Okeechobee have supported a large acreage of submerged vascular plants in years with moderate to low water levels, but the acreage has been reduced to near zero following multiple years with very high water.

A reduction in the occurrence of high water levels as a result of implementing the Comprehensive Plan is expected to cause widespread increases in the submerged aquatic vegetation in Lake Okeechobee. This, in turn, will give rise to clearer water, help to lower phosphorus concentrations, and provide conditions conducive to a healthy community of fish, wading birds, and other wildlife. The extent to which fish and birds will recover following a sustained recovery of these plants remains to be seen, and is a major focal area of ongoing research.

Recent Status and Trends

When spatial extent of the submerged aquatic vegetation was measured by the University of Florida during and just after a period of low lake stage and regional drought in 1989-1991, between 43,000 and 51,000 total acres were found (Figure 7b-2-4). Between 13,000 and 22,000 acres were covered by vascular plants, with the remainder covered by *Chara*. Submerged vegetation was not sampled between 1991 and 1997. In 1998, after many years of high lake stage, a rough estimate by the Florida Fish and Wildlife Conservation Commission indicated that only 3,000 acres of total submerged vegetation remained in the lake. A detailed survey was conducted by the SFWMD in 2000 immediately after a managed lake recession. The survey indicated that the community had recovered to near 45,000 total acres, with over 15,000 acres of vascular plants. Much of this submerged vegetation was lost when an extreme drought in 2001 dropped water levels below 9 feet, a historic low for this lake. However, in late summer 2001, approximately 6 weeks after stage increased again to over 12 feet, the community began to recover. At the end of the 2001 summer growing season (September) the lake supported approximately 34,000 total acres of submerged plants, with just over 9,000 acres of vascular plants.

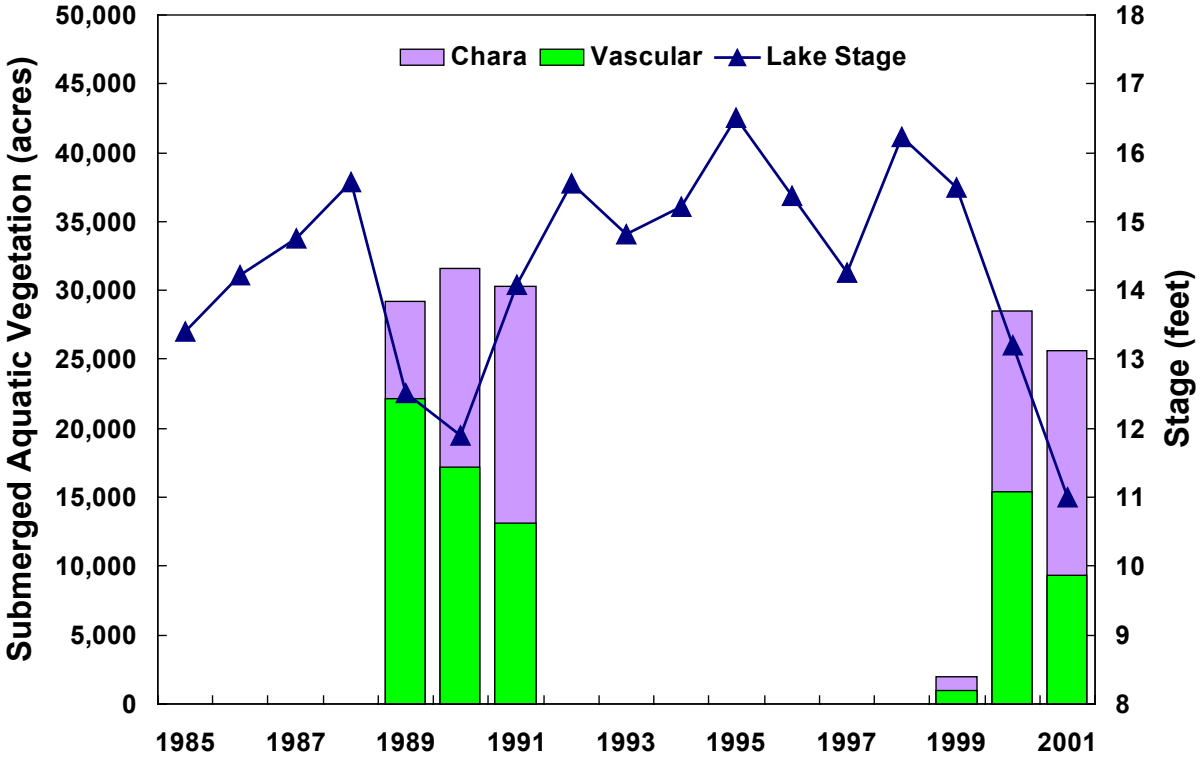


Figure 7b-2-4. Submerged Aquatic Vegetation and Lake Stage over time for Lake Okeechobee

INDICATOR GRADE

The indicator grade was red until 2000, when the SFWMD lowered the lake in a managed drawdown, allowing the vegetation to recover. The current grade is yellow. Projects are not yet in place to ensure long-term survival of large beds of submerged aquatic vegetation in the lake.

RESTORATION ACTIONS

One of the most important features of the Comprehensive Plan for reducing the occurrence of high depths in the lake is aquifer storage and recovery. The Aquifer Storage and Recovery Pilot Project is proceeding on schedule.

HEALTH OF AQUATIC ANIMAL COMMUNITIES IN THE INTERIOR EVERGLADES RIDGE AND SLOUGH SYSTEM

COMPREHENSIVE PLAN TARGETS

Certain species of marsh fishes, frogs, crayfish and aquatic snails are good indicators of the overall health of the freshwater Everglades ridge and slough system. To measure the system's responses to longer, more natural hydroperiods and reduced levels of contaminants, four restoration targets have been established:

- **Animal density** - Increase the numbers and density of native marsh fishes, pig frogs, and apple snails
- **Size distribution** - Increase the size range of marsh fishes by increasing the frequency of larger fishes
- **Relative abundance** - Increase the relative abundance of native sunfishes and chubsuckers, increase the frequency of the species of crayfish typical of long hydroperiod marshes (*Procambarus fallax*) in relation to the species more characteristic of shorter hydroperiod marshes (*P. alleni*), and maintain or reduce the current low frequency of exotic species of fish in the interior marshes
- **Contaminants** - Reduce levels of mercury and other toxins in marsh fishes

SIGNIFICANCE AND BACKGROUND

Fish, aquatic invertebrates, and frogs are critical members of the Everglades food web, and are especially important because of their role in the diets of wading birds and alligators. The nesting success of wading birds is strongly influenced by the amount of food available in the marshes. Most wading bird species consume fish as a portion of their diet, and many species, such as the white ibis, also consume large quantities of crayfish. Apple snails serve as food for a number of birds, notably the endangered snail kite. Fish and frogs are also important in the diet of alligators. In addition, pig frogs are economically important in the water conservation areas, where they are actively harvested for commercial sale.

The species or groups of species selected as indicators of Everglades health are known to be sensitive to changing patterns of hydrology and water quality, responding to management actions in a short time period (months or a few years). All of these species do best in marshes that remain flooded indefinitely. All have suffered from water management practices that have substantially increased the number and duration of marsh dry-outs.

RECENT STATUS AND TRENDS

Everglades National Park personnel have collected records of fish density for over 20 years at two locations in Shark River Slough: one in the main slough south of the S-12C structure (SRS) and one in northeastern Shark River Slough east of the L67E levee (NESRS). In 1985, the Modified Water Delivery Program altered the management of the NESRS site to recreate historical, wetter condition. Since management at the SRS site was not modified at that time, it

can be considered as a reference area. Comparing these two sites provides an insight into the effect of manipulating hydrology as an ecological restoration tool for the Everglades.

Our assessment protocol indicates that the conditions at the SRS site were much more similar to conditions predicted by the Natural Systems Model (NSM) during the period from 1971 to 1995 than the conditions at the NESRS site. From 1981 to 1986, the SRS site actually had more fish than predicted by the NSM, because managers kept the site from drying out in 1981 when NSM predicted it should have dried. In contrast, the NESRS site had fewer fishes than predicted by NSM throughout this period. In 1999, the density of fishes in the NESRS and the SRS reference site were the same, providing some support that restoration goals were met by this experimental water delivery.

In recent years, the level of mercury recorded in mosquitofish has decreased, possibly linked to the series of wet years. Continued monitoring is needed to determine if this positive trend is maintained through dry years like 2001.

No change has been indicated in the status of exotic fishes in these habitats. They continue to be present in very low numbers. The dry years of 1989 and 1990 corresponded to the range expansion and boom in abundance of at least one nonnative fish, the pike killifish. Monitoring in 2001 and beyond should be focused on identifying any similar patterns following the dry period.

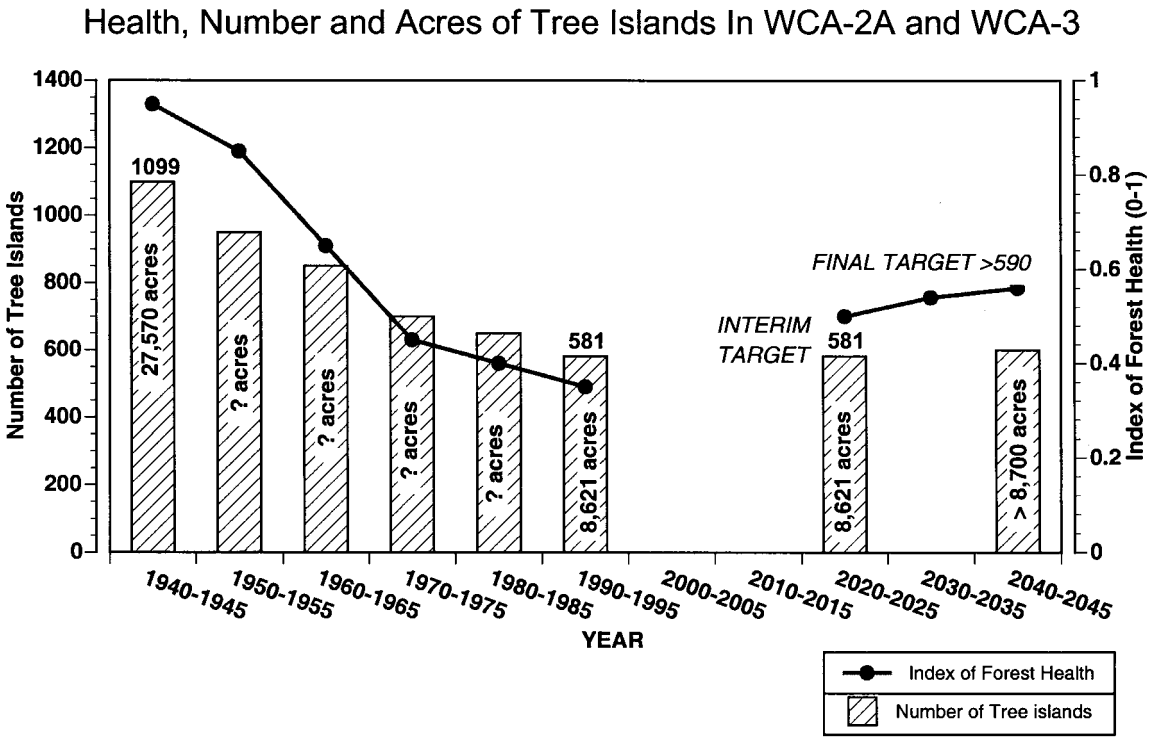
INDICATOR GRADE

RESTORATION ACTION

EVERGLADES TREE ISLANDS RECOVERY

COMPREHENSIVE PLAN TARGET

A density-weighted tree island "health index" that ranges from zero (death is imminent) to one (completely stress free) is based on tree island canopy density and diversity, exotic plant density, and tree growth. The Comprehensive Plan target for Water Conservation Area (WCA) 2 and WCA 3 is to increase the health index by 25 to 50 percent and prevent any further reduction in tree island area (**Figure 7b-2-5**).



Note: Historic trends from 1950 to 1985 were estimated.

Figure 7b-2-5. Historic Values for the Index of Forest Health Assumes that Tree Islands in 1940 were near optimum health. An interim Tree Island target is a positive trend for this index and no net loss. An interim target for WCA-1, Big Cypress and Everglades National Park should be to maintain current density and health

SIGNIFICANCE AND BACKGROUND

Tree islands occur throughout the Everglades marshes. These islands are small, isolated "high spots", which have historically provided essential habitat for a wide variety of plants and animals. The islands serve as places of refuge for animals during periods of high water. They are sources of food and cover for wildlife, and provide nesting sites for wading birds and freshwater turtles. Tree islands are highly important to the culture of both the Miccosukee and Seminole Tribes. Hunters, fishermen, and recreational visitors into the Everglades consider tree islands to be symbolic of the health of the entire ecosystem. **Figure 7b-2-6** illustrates the trends, importance, attributes, and stressors associated with tree islands.

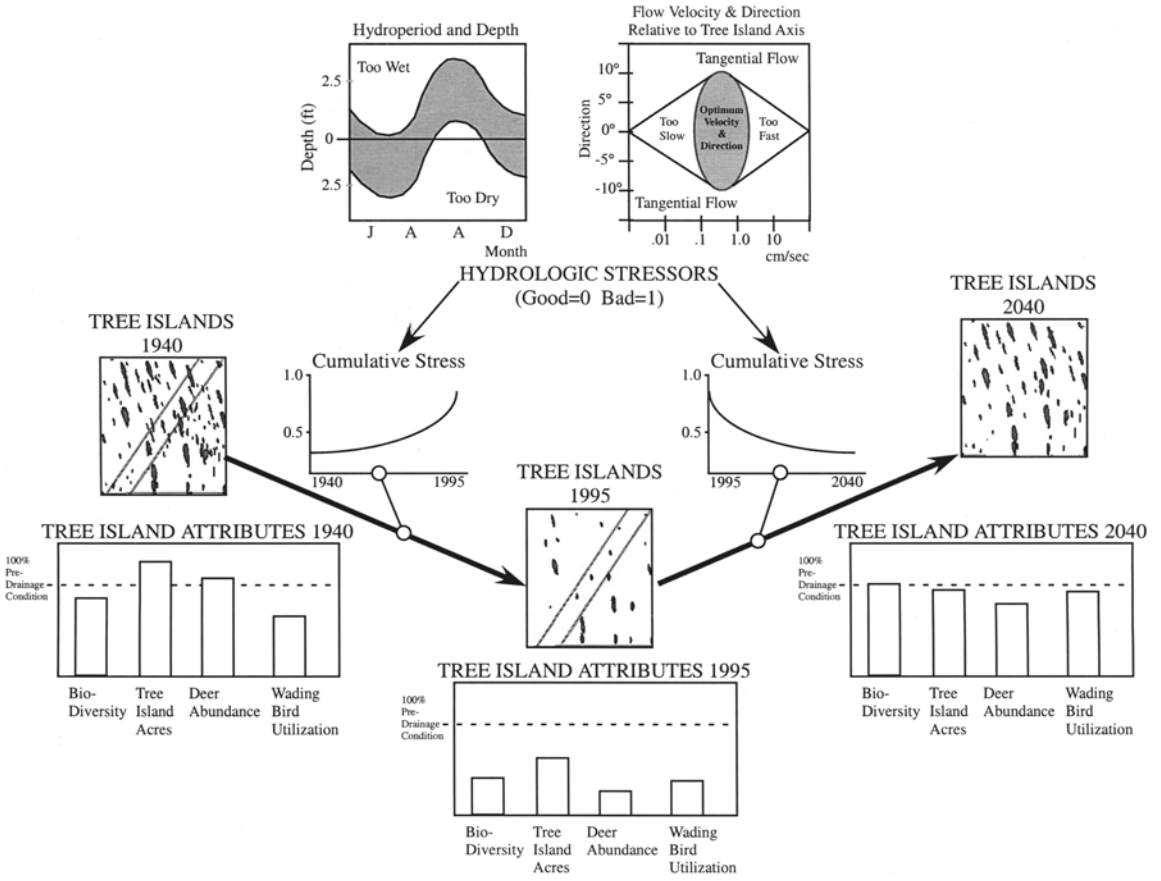


Figure 7b-2-6. The Ecology of Tree Island Historic and Predicted Change in the Everglades

Because the maximum elevation of the highest tree islands is only slightly above the maximum water levels in the surrounding marshes, tree islands with their less flood-tolerant vegetation are very sensitive to unnaturally deep water. Unnaturally deep water can occur in regions where water flow is impeded and dammed. However, relatively deep water can also occur when tree islands lose elevation. Elevation loss occurs when the system is too dry for too long

and the peat soils become oxidized or burned. Water management practices have substantially increased how often and how long the water is unnaturally deep in WCA 2 and WCA 3, resulting in the loss or degradation of many tree islands.

RECENT STATUS AND TRENDS

Comparisons of the number, size and distribution of tree islands between 1940 and 1995 in WCA 2A show that only four of the original 58 tree islands have survived the past 55 years. Three of the four remaining islands are stressed and continue to lose trees. Similar comparisons for WCAs 3A and 3B show a reduction from 1,041 to 577 tree islands (a 45 percent reduction), and a reduction in total acreage of tree islands from 24,700 to 8,600 acres (a 65 percent reduction).

INDICATOR GRADE

The tree island grade is red. The relatively high water conditions from 1995 to 1999 were a stress on tree islands. The relatively dry years of 2000 and 2001 could have been catastrophic. However, tree islands did not burn and none were destroyed during the drought. Individual islands appear healthy despite the drought of 2001. This was due to the fact that the dry conditions were good for hardwood seed germination and sapling development. Sapling survival will depend upon the amount of tree island soil oxidation (and hence elevation loss) relative to the return of high waters during the 2001–2002 wet season. Currently, the existing tree islands in WCA 2 or WCA 3 show no evidence of recovery.

RESTORATION ACTION

Large-scale peat burns and tree island loss were prevented in WCA 3 despite extreme drought conditions. The lack of muck burns was accomplished by rapidly developing an Everglades drought severity index to demonstrate the need for water use restrictions. Other actions in 2001 included 1) the issuing of a remote sensing contract to help develop an inexpensive tool for measuring island tree mass and canopy density for the establishment of a Tree Island Health Index and 2) the development of a tree island model for the prediction of recovery rates in WCA-2.

NUMBER OF STABLE SUBPOPULATIONS OF THE CAPE SABLE SEASIDE SPARROW IN THE EVERGLADES MARL PRAIRIES

COMPREHENSIVE PLAN TARGET

Increase the number of stable subpopulations of the Cape Sable seaside sparrow from one to three with one subpopulation west of Shark River Slough and two east of Shark River Slough. A subpopulation will be considered stable when it supports a minimum of 1,000 individuals, measured as a five-year running average. Because the one currently stable subpopulation typically supports 1,800 to 2,400 individuals, the goal for the total number of Cape Sable seaside sparrows would be a minimum of approximately 4,000 individuals, with a final restoration target of 6,000 individuals, measured as a five-year running average.

SIGNIFICANCE AND BACKGROUND

The Cape Sable seaside sparrow lives only in the marl marshes of the southern Everglades. It is listed as an endangered species by both the U.S. Fish and Wildlife Service and the Florida Fish and Wildlife Conservation Commission. The sparrow's dependence on these short-hydroperiod marl prairies makes it an excellent indicator for healthy marl-forming wetlands that support a mosaic and diversity of plants.

Three major stresses have led to steep declines in sparrow numbers and distributions. Shortened hydroperiods (i.e., less time with water levels above ground) in the eastern marl prairies, caused by water management practices, have altered sparrow habitat through increased fires and expansion of woody plants. In the western marl prairies, increased hydroperiods and unnatural dry season flooding, also caused by water management practices, have increased areas dominated by sawgrass and caused the sparrow breeding season to be interrupted. The third major stress is loss of spatial extent of short-hydroperiod marl areas due to human agricultural and urban development.

RECENT STATUS AND TRENDS

The number of sparrows in the western subpopulation suffered an approximately 90 percent decline in the early 1990s and has remained below 500 (**Figure 7b-2-7**). Overall numbers declined approximately 50 percent during the same period and have not recovered.

INDICATOR GRADE

No elements of the Comprehensive Plan have been implemented, and no sustained increase in sparrow numbers has occurred. The Cape Sable seaside sparrow grade is red.

RESTORATION ACTION

Significant improvement in hydroperiods should be provided by the implementation over the next few years of restoration projects planned prior to the Comprehensive Plan, such as Modified

Water Deliveries to Everglades National Park. The Comprehensive Plan will not increase the spatial extent of possible sparrow habitat areas, but does have the potential to further address hydrologic stressors through reduction of dry season water level reversals and restoration of hydroperiods supporting mixed marl prairie habitats.

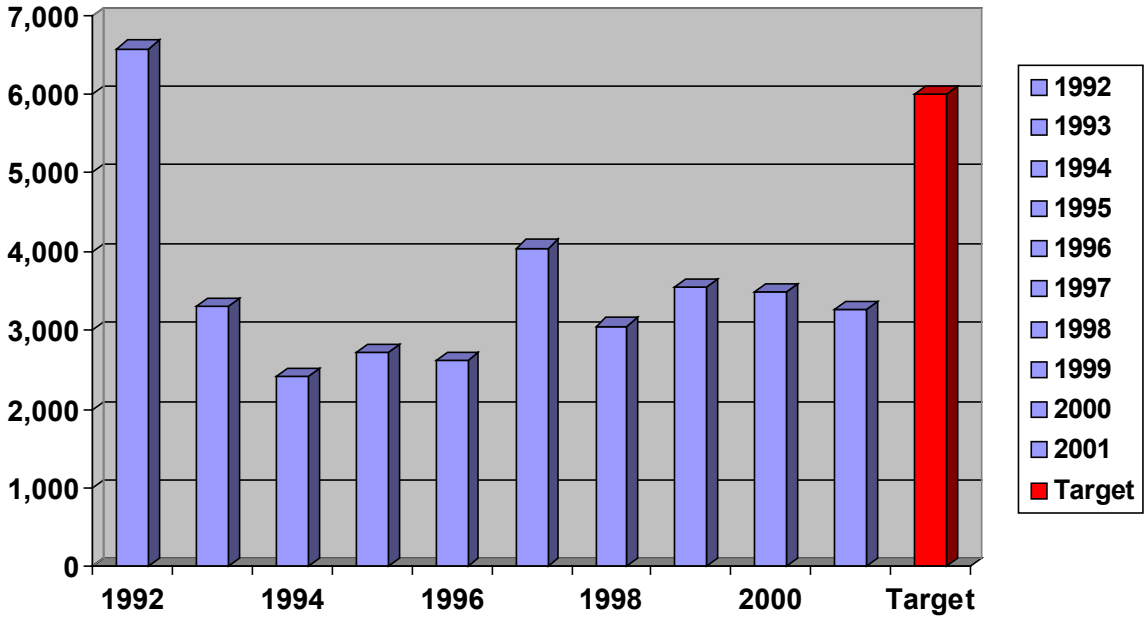


Figure 7b-2-7. Trends in Cape Sable Seaside Sparrow Numbers

ROSEATE SPOONBILL NESTING PATTERNS IN THE SOUTHERN MANGROVE AND FLORIDA BAY ESTUARIES

COMPREHENSIVE PLAN TARGET

One result of implementing the Comprehensive Plan should be the reestablishment of roseate spoonbill (**Figure 7b-2-8**) nesting patterns in the Southern Mangrove and Florida Bay Estuaries. The targets for reestablishing roseate spoonbill nesting patterns are to achieve roseate spoonbill nesting success in seven out of every ten years; return breeding spoonbill numbers to 1,000 pairs nesting in Florida Bay annually, half of which would be located in the northeastern region of the bay; and reestablish spoonbill nesting along the southwestern Gulf Coast between Lostman's River and the Caloosahatchee River. To achieve these patterns, the wet-dry seasonal variation in coastal wetland water levels must be restored to those similar to predrainage conditions and a freshwater or low-salinity prey fish (i.e., fish that birds eat) community must be established within the coastal wetlands.

Figure 7b-2-8. Roseate-Spoonbills in Florida Bay (Photo by John LeClair)

SIGNIFICANCE AND BACKGROUND

The character of an estuary is chiefly determined by the influence of its freshwater source. During the 1960s and 1970s, water management practices had an increasingly adverse impact on the estuaries, altering the timing, distribution, quantity, and perhaps, quality of the fresh water

flowing from the Everglades. Recent studies have verified the links between coastal wetland hydrology and prey fish abundance on these wetlands and nesting patterns of roseate spoonbills that use these fishes as a primary food resource. These studies indicate that roseate spoonbills and their prey are good indicators for evaluating the effectiveness of the Comprehensive Plan on restoring estuarine conditions.

Spoonbills are highly dependent upon the water being at specific levels at certain times of the year. This is due to their unique feeding strategy, which evolved along with the natural cycles of the wet and dry seasons in tropical and subtropical estuaries. Roseate spoonbills feed primarily on small fishes found in shallow wetlands. Naturally high water levels during the wet season promote conditions that allow these fish to reproduce. During the dry season, when water levels fall, these small fishes become highly concentrated in the remaining pools and creeks. This allows the spoonbills to easily catch these fish in large enough quantities to feed themselves and their quickly growing offspring. This food resource is also important for the survival and breeding success of many other species of wading birds, crocodilians and game fishes. The recent effect of water management practices has been to alter this annual cycle in prey abundance such that the quality of feeding habitat for spoonbills nesting in Florida Bay has deteriorated. Restoration of more historic hydrological conditions should promote greater prey abundance and availability, leading to an increase in the number of years spoonbills succeed in nesting.

Prior to a significant European presence, limited evidence indicates that at least 2,000 pairs of spoonbills nested in Florida Bay and along the southwestern Gulf Coast. However, between 1850 and 1930, the spoonbill population in south Florida was annihilated by plume and subsistence hunters. Only 15 pairs were present in 1935. Beginning in the 1940s, this population steadily increased in Florida Bay under the protection first from Audubon wardens and then by the U.S. National Park Service (**Figure 7b-2-9**). This increase was made possible because the places in the coastal estuaries where Florida Bay spoonbills did most of their feeding remained healthy. The population in the bay peaked in 1979 at about 1,250 nests baywide with more than half the nests in the northeastern bay. Numbers nesting in Florida Bay have declined since 1979. No spoonbills have returned to nest along the southwestern coast. Spoonbills are now listed as a "Species of Special Concern" by the Florida Fish and Wildlife Conservation Commission.

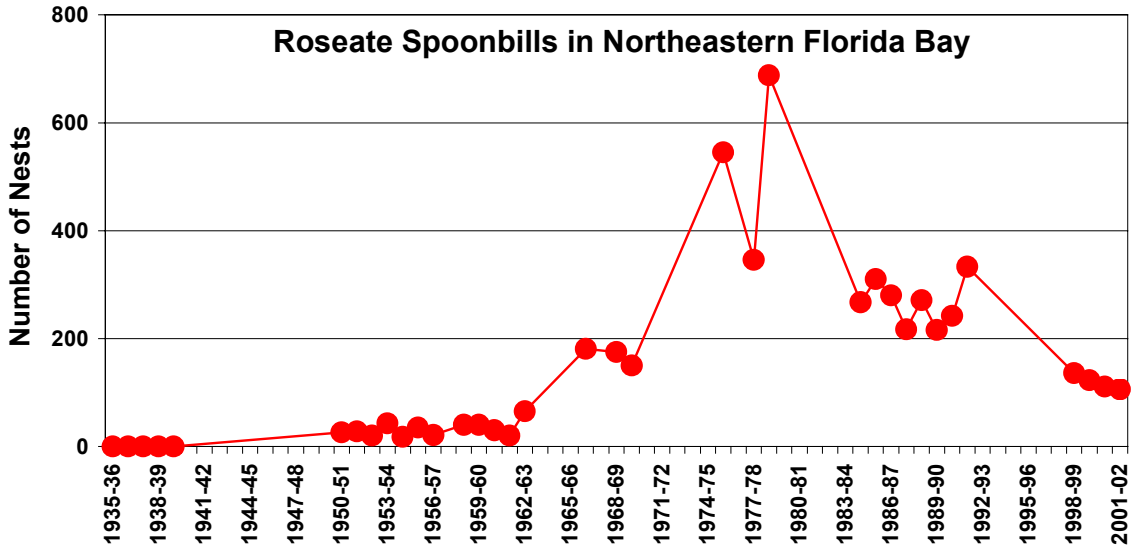


Figure 7b-2-9. Number of Roseate Spoonbill nesting pairs in Northeastern Florida Bay. These birds are dependant on the wetlands north of bay (i.e., those impacted by the C-111 canal) for food. The decline in recent decades coincides with completion and operation of the South Dade Conveyance System.

STATUS AND TRENDS

Unfortunately, lack of funding once again limited our ability to perform a total count for all of Florida Bay in 2002. However, nest counts of the northeastern colonies indicate that spoonbill use continues to decline and was the lowest recorded since 1963. Nesting success estimates clearly indicate that, this year, spoonbill nest production on a baywide scale was the highest in 10 years. The complementary forage fish data supports previous findings that spoonbill nesting success is dependant upon prey availability and hydrological conditions on proximal foraging grounds. Even though this was a successful year in northeastern Florida Bay, the combined results of an overall regional decline in effort in the northeast and a linkage between success and foraging quality indicate that the northeastern foraging grounds are not as reliable as they were 25 years ago. As indicated elsewhere, this decline seems to be related to water management practices associated with the C-111 canal and the South Dade Conveyance System.

INDICATOR GRADE

RESTORATION ACTION

SEAGRASS BEDS AND PINK SHRIMP HEALTH IN FLORIDA BAY

COMPREHENSIVE PLAN TARGET

The key biological targets for restoration of Florida Bay will include seagrass beds, the main aquatic habitat of the bay, and an important animal species that uses this habitat, the pink shrimp. Physical targets include salinity and algal bloom thresholds. For seagrass beds, the target is a diverse community with a moderate density of plants and widespread coverage of the bay bottom. For pink shrimp, the target is a highly productive commercial pink shrimp harvest from the Dry Tortugas fishing beds. Shrimp harvest rates should meet or exceed 520 pounds of combined small and large shrimp per vessel-day fished. Salinity targets only reflect the magnitude of salinity levels and not the variability of salinity. Threshold salinity levels of 20 parts per thousand (ppt) for eastern Florida Bay and 30 ppt for western Florida Bay are the targets. Algal bloom threshold targets are 2 parts per billion (ppb) of chlorophyll *a* in eastern Florida Bay and 3 ppb of chlorophyll *a* in central and western Florida Bay. More refined targets for Florida Bay restoration are being developed by the Florida Bay and Florida Keys Feasibility Study.

SIGNIFICANCE AND BACKGROUND

Florida Bay has sustained ecological damage in association with the drainage of the Everglades and other human activities. The most apparent changes in the bay's ecology have been the occurrence of seagrass die-offs, sustained algal blooms, and declines in lobster, fish and shrimp species.

It is expected that Florida Bay restoration will involve changes in freshwater flow that will not only increase the quantity of this flow, but also alter the timing and distribution of flow. A direct effect of freshwater flow restoration will be a change in the bay's salinity. The change in salinity will then affect seagrasses and shrimp.

Another potential result will be improved water quality. Lowering the nutrients coming into the bay will decrease the occurrence of algal blooms. Such blooms often occur with nutrient pollution and can negatively affect seagrass habitat and other ecosystem characteristics.

Seagrass beds are generally considered to be the keystone of the entire ecosystem, providing critical food and habitat for shrimp, fish and other organisms. Seagrass beds also help to stabilize the bay's sediments, thus promoting clear water and helping to minimize algal blooms. Seagrass plants are known to be sensitive to salinity change.

Pink shrimp are also sensitive to salinity change. They are an important link in the bay's food chain. Shrimp are food for fish and are also an economically important target species. Florida Bay has been identified as a major pink shrimp nursery ground. A statistical link between the volume of freshwater flow into the estuaries and Tortugas shrimp catch rates has been determined by previous studies. Shrimp harvests declined greatly in the 1980s, but are expected to benefit from restoration actions.

RECENT STATUS AND TRENDS

Florida Bay salinity, which has been monitored since 1991, was lowest in the mid-1990s when rainfall was above average. In 1995 and 1996, more than one-third of observations were below threshold salinity values, but salinity increased in 2000 (yielding a decreasing indicator value). With restoration, higher indicator values are expected to be more common during average or below-average rainfall years.

Algal blooms were not measured in Florida Bay prior to the 1990s, but are thought to have been rare. These blooms were highest in 1993, 1994, and 1999. Blooms in 1999 appear to have been stimulated by Hurricane Irene.

Seagrass habitat improved considerably since 1997, but, nevertheless, declined slightly since 1999. The first quantitative survey was done in 1984 and surveys have been done annually since 1994. Improvement in seagrass habitat has been associated with not only fewer turtle grass die-offs, but also extensive growth of shoal grass in many areas that had experienced this die-off. This improvement followed years with increased freshwater flow and lower salinity.

The indicator for pink shrimp (Dry Tortugas harvests) showed a general decline since the 1960s and 1970s, particularly for relatively large shrimp. The indicator showed improvement in the mid-1990s, but has since declined again. In the past year, small shrimp showed a marked decline, while large shrimp remained as in recent years.

INDICATOR GRADE

The grade for Florida Bay over the past several years has been yellow, based on lower salinity, improved seagrass habitat coverage, and indications of improved pink shrimp harvests. Much of this improvement, however, may have been because of relatively high rainfall in the mid-1990s. During the past year, rainfall and freshwater flow was low and each of these indicators also declined. The occurrences of algal blooms, which may be related to freshwater flows, remain a concern.

RESTORATION ACTIONS

Restoration actions for Florida Bay during the 1990s included the Emergency Interim Plan to increase freshwater flow to the bay, the Experimental Water Deliveries Test 7, the C-111 Project, and Modified Water Deliveries. The C-111 Project has made substantial progress with the removal of spoil mounds south of the C-111 canal in late 1997 and the completion of a bridge over northern Taylor Slough in late 2000.

No Comprehensive Plan projects have been implemented yet for Florida Bay restoration. Actions specifically designed for the bay will require completion of the Florida Bay and Florida Keys Feasibility Study. This study will develop modeling tools, assess restoration alternatives, and select a recommended plan for bay restoration within four years.

WADING BIRD NESTING PATTERNS FOR THE TOTAL SYSTEM

COMPREHENSIVE PLAN TARGET

The restoration goal for wading birds in the wetlands of south Florida is to recover numbers of nesting birds that are much more similar to the number that nested here under pre-drainage conditions. The earliest measure we have of the number of wading birds that once nested in the Everglades basin is information from the 1930s and 1940s, at a time when the greater Everglades region was much less disturbed than the current system. For the five most common species that nested in the former Everglades colonies, the average annual number for the 1930s/1940s was 1,125 nesting pairs of great egrets (range, 250–4,000 pairs), 5,000 pairs of snowy egrets and tricolored herons combined (range, 250–16,000 pairs), 37,000 pairs of white ibis (range, 10,000–100,000 pairs), and 2,300 pairs of wood storks (range, 1,000–4,000 pairs). We have no comparable numbers for the Big Cypress basin except for storks. Approximately 5,000–10,000 pairs nested in the Corkscrew and Sadie Cypress colonies is some years during the period 1920s–1960. As a requirement for meeting these numerical goals, wading birds may need to reoccupy the now largely abandoned estuarine colony sites in southern and western Everglades National Park, and recover a pattern of forming the extremely large “super colonies” in some years. In addition, wood storks must be able to return to more natural timing patterns for nesting (between November and January) than current water management practices allow.

SIGNIFICANCE AND BACKGROUND

Large numbers of showy wading birds were a striking feature of the predrainage wetlands of South Florida. Single nesting colonies once contained as many as 50,000 to 100,000 pairs of birds. Although most of these colonies were decimated by plume hunters late in the 1800s, protective legislation and good habitat conditions during the early 1900s allowed most of the nesting species to fully recover.

Epitomizing the former nesting by wading birds in the Everglades was the huge traditional "rookery" that was located along Rookery Branch in the extreme upper reaches of Shark River. This super colony was estimated in 1934 to have been a mile in length and several hundred feet wide. These “bird cities” contained 75 to 95 percent of all wading birds nesting in the predrainage Everglades. No large colonies have formed at Rookery Branch since the early 1970s.

The total number of wading birds nesting in the greater Everglades region has declined by about 90 percent from the maximum number that nested there in the 1930s. This decline was a direct consequence of drainage and water management practices between the 1940s and the 1990s. Substantial reductions in the total area of wetlands, changes in the location, timing and volumes of flows, and the creation of unnatural water impoundments in the Everglades have been the factors that have combined to disrupt traditional nesting patterns, leading to declines in the total numbers of birds. These changes to the hydrology of the system have caused storks to delay nesting by several months, which has resulted in many pairs failing to raise young birds.

Colonies that have been forced to relocate to the Everglades water conservation areas have been smaller and, perhaps, less successful than were the colonies in the traditional estuarine rookeries such as Shark River. It is thought that prior to the reduction in flows into the estuaries,

these areas produced much more of the food required to support the former bird cities, and that these large rookeries may only be recovered in the Everglades once natural estuarine flows are recovered.

RECENT STATUS AND TRENDS

The total numbers of nesting wading birds in the Everglades for the past three years, 1999 to 2001, has been higher than for almost any year since the late 1970s. In 2001, the total number of nesting pairs for the five species in the Everglades was 5,450 great egrets pairs, 3,600 snowy egret pairs, 2,200 tricolored heron pairs, 17,300 white ibis pairs, and 2,050 wood stork pairs. The total for the five species was 30,600 nesting pairs. By species, the number in 2001 substantially exceed the average annual nesting effort for Great Egrets in the 1930s–1940s time period, closely matched the average nesting effort for snowy egrets, tri-colored herons, and wood storks, and is about one-half the average effort for white ibis. For the five species combined, the nesting in 2001 was about one-fourth the maximum nesting effort for the five species in the earlier time period.

No progress was made in 1999 to 2001 in recovering the traditional estuarine nesting colonies. Only 1.6 to 4 percent of the wading birds that nested in the greater Everglades used the estuarine sites. Storks in the Everglades, presumably stimulated by the rapid drying began nesting in January and February. No storks nested at Corkscrew Swamp Sanctuary in 2001, the major stork nesting site in South Florida.

INDICATOR GRADE

The total number of nesting pairs for the five indicator species in 2001 was substantially higher than the number of pairs during a baseline period (1986 to 1995). However, little progress was made in 2001 towards meeting the goals for colony location and timing patterns for nesting birds. Although not influenced by the Comprehensive Plan, the increased nesting effort in 2001 calls for a grade of yellow.

RESTORATION ACTION

Projects developed prior to the Comprehensive Plan, such as Modified Water Delivery to Everglades National Park, will be implemented over the next few years and should result in a significant improvement in hydroperiods. Planning has begun on the CERP Decompartmentalization Phase 1 Project, which will remove barriers to sheetflow and restore additional flows to Everglades National Park.

AMERICAN ALLIGATOR DISTRIBUTION AND ABUNDANCE IN WETLAND COMMUNITIES THROUGHOUT THE SYSTEM

COMPREHENSIVE PLAN TARGET

The restoration targets for the American alligator are to recover more natural numbers and distribution patterns across the major wetland communities in South Florida. Current, specific targets are as follows:

- Increase the abundance of alligators in the ridge and slough habitats of Everglades National Park and Water Conservation Areas 2 and 3 to more closely match the more natural levels of abundance now found in the Arthur R. Marshall Loxahatchee National Wildlife Refuge
- Recover more natural patterns of sizes of animals indicative of healthy regional populations (not biased to adult males)
- Recover healthy alligator populations in the southern Everglades marl prairies and estuarine creeks and rivers

SIGNIFICANCE AND BACKGROUND

Alligators are a keystone species in the Everglades. They play a major role in influencing the overall health and ecological patterns of the region. They create pathways that become important wetland trails for many aquatic animals. Alligator ponds are places for wetland animals to live and survive during periods of low water. Alligator nest mounds become "high ground" for other animals during periods of flood, and also provide places for turtles to lay their eggs safe from flooding.

Alligators were abundant in the predrainage Everglades basin. The highest numbers of alligators occurred in the less deeply flooded areas of the natural system, such as the expansive cypress swamps of southwestern Florida and the broad marl prairies to the east and west of the southern Everglades, and in the freshwater creeks and rivers that drain into the coastal mangrove swamps.

Currently, alligators are much less numerous in the marl prairies and mangrove streams than they were historically. The numbers of alligators in unnatural habitats, such as canals, are high compared to adjacent marshes.

Comprehensive Plan projects are expected to recover more natural regional hydropatterns and change the location and extent of canals throughout the system. The result will be an increase in alligators in the marl prairies as they are able to reoccupy these restored wetlands. Alligators also should increase in the mangrove fringe areas as a result of an increase in freshwater flows and reduced salinity and in the marshes adjacent to where canals are removed and in overdrained areas, such as northern Water Conservation Area 3A, once wetter hydropatterns have been restored.

RECENT STATUS AND TRENDS

Surveys in the 1950s in the freshwater streams of Whitewater Bay in Everglades National Park indicated a count of 50 to 100 alligators during a 5- to 6-hour survey. Similar surveys in 1965–1966 found no alligators in these same areas. Surveys in 1998 showed approximately one-fourth of the number observed during the 1950s. Few alligators now occur in the marl prairie regions where alligators once occupied many ponds. Recent alligator relative abundance in Arthur R. Marshall Loxahatchee National Wildlife Refuge, perhaps closer to historical numbers, has been two to five times greater than in similar habitats in Water Conservation Areas 2 and 3 and in the Shark River Slough portion of Everglades National Park.

INDICATOR GRADE

The indicator grades for American alligator distribution and abundance is red for marl prairie communities, yellow for marshes, and orange in the estuary.

RESTORATION ACTION

SPATIAL EXTENT OF HEALTHY FRESHWATER WETLANDS THROUGOUT THE TOTAL SYSTEM

COMPREHENSIVE PLAN TARGET

Healthy wetlands exist in areas where natural patterns of surface and ground water and fire are the dominant processes shaping plant and animal communities. These patterns can be those that existed prior to human alteration of the system or they can be new regimes that are considered appropriate for the landscape that will exist following restoration. Other human influences that are not driven necessarily by alterations in water and fire patterns, but which have still significantly impacted wetlands include excess nutrients and invasive native and exotic plants. Thus, the target for increasing the spatial extent of healthy freshwater wetlands includes establishing appropriate water and fire patterns throughout the area to be restored. Water patterns include depth and duration of flooding, timing, and flow. In addition, invasive native and exotic plants should not make up more than 5 percent of the vegetative cover.

SIGNIFICANCE AND BACKGROUND

Healthy wetlands can take many forms depending on the environmental setting and history of each site. Communities in deep wetlands differ from those in shallow wetlands due to the direct effects of hydrology on species with different flood tolerances. Hydrology also affects the occurrence of fires, which in turn sorts out plant communities that are more or less tolerant of fire. Those areas with frequent fire tend to be dominated by herbaceous communities, with wet prairies on shallower sites and marshes on deeper sites. As fire becomes less frequent, woody vegetation becomes more prominent. Shrubs are the first to come into these communities, such as wax myrtle into wet prairies and willow and buttonbush into marshes. Next, trees come to dominate a site. Different tree species' tolerance of fire varies considerably. Pines, which are found in shallow wetlands, and cypress, which are in deeper wetlands, are much more tolerant of fire than are hardwoods, such as maples, bays and hollies. The latter have gradually expanded their originally very limited distribution in South Florida as a result of the long-term absence of fire in many areas.

Native plant communities are adapted to the low nutrient concentrations that are characteristic of South Florida surface waters. When concentrations of nutrients, such as phosphorus, increase, a transition to other community types occurs. In this way cattails, an invasive native species, are able to replace the original sawgrass community under the new higher nutrient conditions. A number of invasive exotic plant species have occupied large areas of South Florida. In some places they have come to completely dominate a site, while on other sites they form a dense ground cover or shrub layer under a native forest.

The large spatial extent of healthy wetlands in the predrainage Everglades basin was fundamentally important to the processes and diversity that defined the ecological characteristics of the basin. The influences of natural disturbances such as large fires, freezes and hurricanes were also necessary for creating and maintaining a complex mosaic of communities and habitats. These mosaics, in turn, provided a wide diversity of animal and plant species with the habitat conditions that assured their long-term survival in such a dynamic South Florida ecosystem. For example, the Everglades basin once supported immense numbers of wading birds in large part because the region's large extent and habitat diversity and, therefore, good feeding and nesting

conditions could usually be located somewhere, regardless of the wide variations in rainfall that characterize the South Florida landscape.

RECENT STATUS AND TRENDS

It would probably be impossible to find a wetland in South Florida that has not been affected by human activity. However, the degree of impact is quite variable. Some wetlands have been completely developed, such as along the southeastern coast, and are not included in the restoration plan. At the other extreme, some areas are relatively unaltered areas and require only a limited restoration effort, such as portions of the eastern Big Cypress Swamp. Between these two extremes, however, are vast areas of wetlands that have been significantly altered, primarily as a result of impoundment of overland sheetflows and diversion of surface waters, increased nutrient loads, and the spread of invasive plants. These latter areas are CERP's main restoration targets.

INDICATOR GRADE

Since healthy wetlands require intact hydrologic and fire regimes, low phosphorus concentrations, and less than 5 percent exotic coverage, only a very limited portion of the South Florida area to be restored meets these criteria. Thus, the grade for extent of healthy freshwater wetlands is red.

RESTORATION ACTION

During the preceding year, no Comprehensive Plan projects that would be expected to result in an improvement in the extent of healthy freshwater wetlands have been implemented. However, other projects are continuing to improve water quality and reduce the cover of invasive exotic plants in portions of the system to be restored by the Comprehensive Plan.

PHOSPHORUS EFFECTS ON NATURAL WETLANDS THROUGHOUT THE TOTAL SYSTEM

COMPREHENSIVE TARGET PLAN

One target of the Comprehensive Plan is to reduce unnaturally high levels of phosphorus in Everglades marshes so that native flora and fauna communities will be recovered. The effects of unnaturally high levels of phosphorous in the Everglades have been most noticeable near canals. Phosphorous levels are reduced the further one travels from structures that allow water to flow into the marshes. Restoration targets for phosphorous levels should be developed for the entire system, with specific interim targets established at sites close to present and future discharge points into the marshes (Figure 7b-2-10). For interior sites that have low phosphorus levels, the interim and long-term targets are to prevent phosphorus levels from increasing. At sites where phosphorus levels are high, the interim target is to reduce the rate of expansion of phosphorus impacts. A long-term target for these areas is the reversal of the nutrient impacts.

A phosphorous index will be developed to measure the recovery or further degradation of the Everglades. This index will be based on concentrations and amounts of total phosphorus in surface water and soils, and in algae (periphyton) and aquatic plants, and on biological measures such as the species composition of periphyton mats and the expanse of cattails. A comparison of phosphorus responses at different levels provides the best approach to assess long- and short-term recovery patterns. For example, periphyton communities respond rapidly to changes in phosphorus concentrations and thus can act as relatively quick indicators of these changes. In contrast, soils are slow to accumulate and can be used to assess long-term trends in phosphorous patterns.

SIGNIFICANCE AND BACKGROUND

The Everglades was naturally a low-phosphorous system, with nutrients primarily provided via rainfall. Most natural populations of Everglades flora and fauna are adapted to low phosphorus levels. Sawgrass strands account for approximately 65 to 70% of the total vegetation cover in the natural Everglades. In many areas, these strands are interspersed with more open communities such as wet prairies, containing rushes and grasses, and deeper-water sloughs, containing water lilies and bladderwort. These open water habitats should be characterized by an abundant native periphyton community (floating and attached algal mats) that provides a habitat and a food source for invertebrates and fish.

Anthropogenic enrichment has resulted in the conversion of open water habitat and sawgrass areas into dense cattail stands. Historically, cattail was a minor component of the Everglades flora and is believed to have occurred primarily in naturally enriched or disturbed locations. No evidence has been found from the predrainage system for the existence of dense cattail stands such as those that now occur over extensive parts of the northern Everglades.

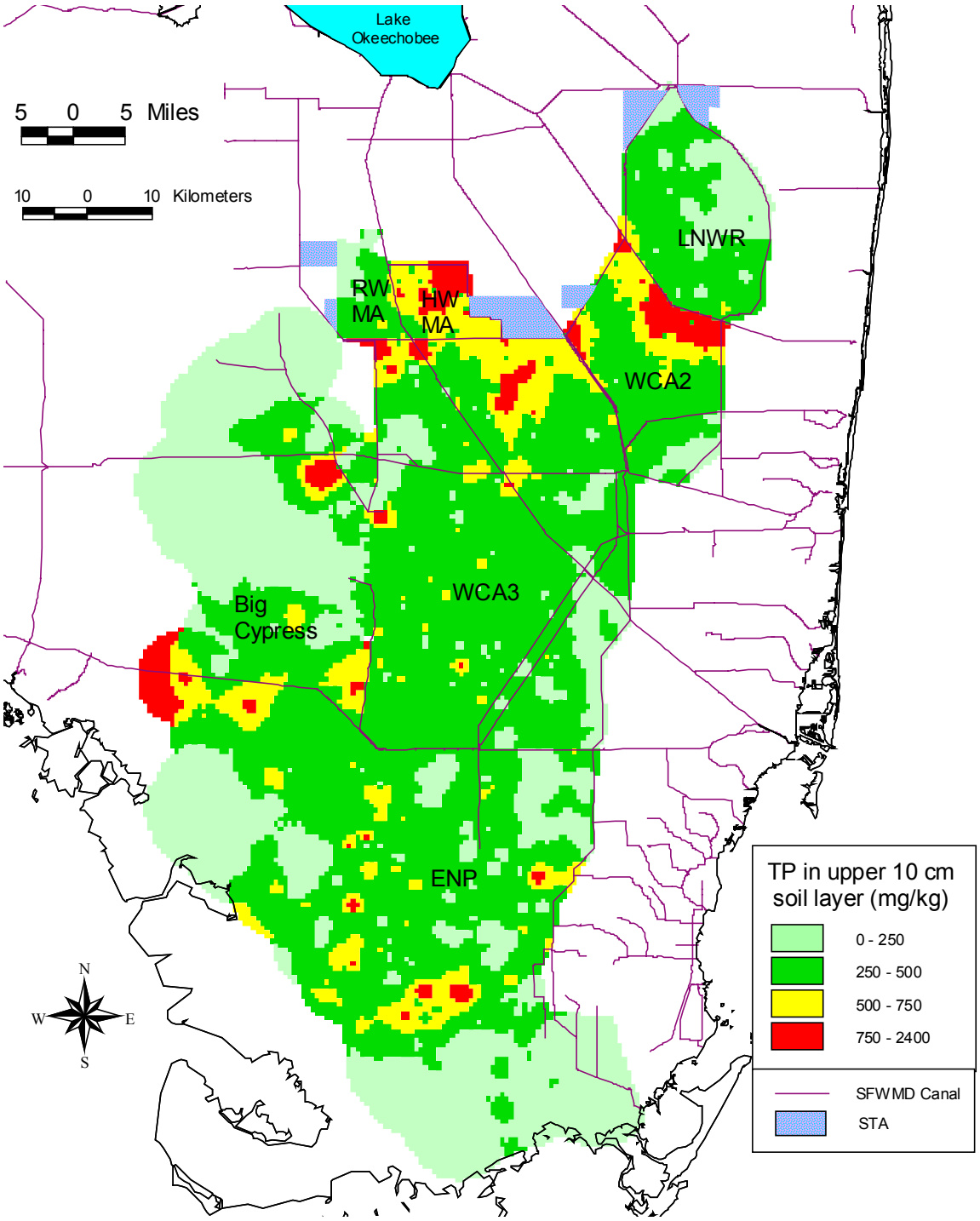


Figure 7b-2-10. Spatial Distribution of Surface Soil (0-10 centimeters) Phosphorus Concentrations Throughout the Everglades (USEPA, 1999; Reddy et al., 1991, 1994; DeBusk et al., 2001; S.M. Smith and S. Newman, unpublished data)

RECENT STATUS AND TRENDS

Vegetation and soil surveys show that phosphorus enrichment is generally associated with inflows from canals into the Loxahatchee National Wildlife Refuge, and Water Conservation Area (WCA) 2A and WCA 3A. Evidence of elevated phosphorus levels is also observed in overdrained northern areas of the Everglades system such as the Holey Land and Rotenberger Wildlife Management Areas (**Figure 1**). Analysis of soil nutrient and cattail distribution in the most enriched portion of the Everglades (WCA 2A) shows that the expansion of the impacted areas' nutrient front has continued throughout the 1990s (**Figures 7b-2-11** and **-12**).

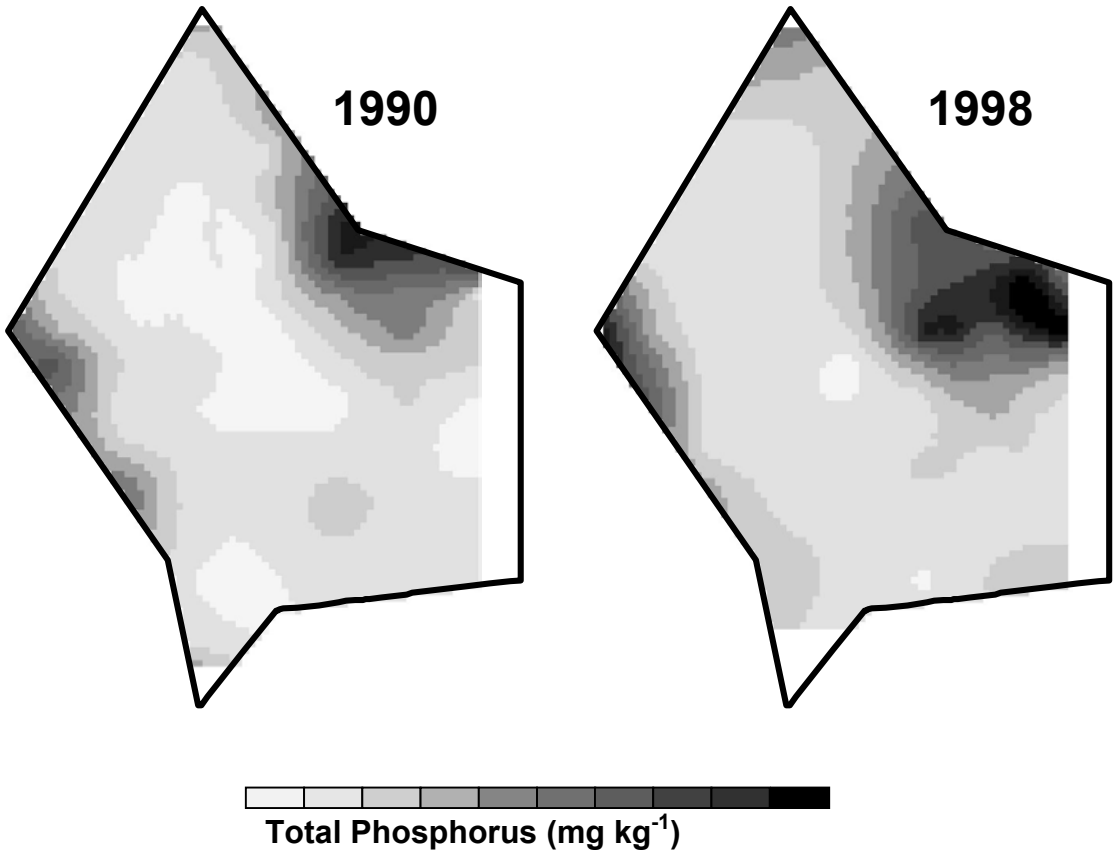


Figure 7b-2-11. Spatial Distribution of Soil Total Phosphorus in WCA 2A, Showing an Increase in Areas of Enrichment from 1990 to 1998 (DeBusk et al., 2001). Units are milligrams (mg) of total phosphorus per kilograms (kg) of soil.

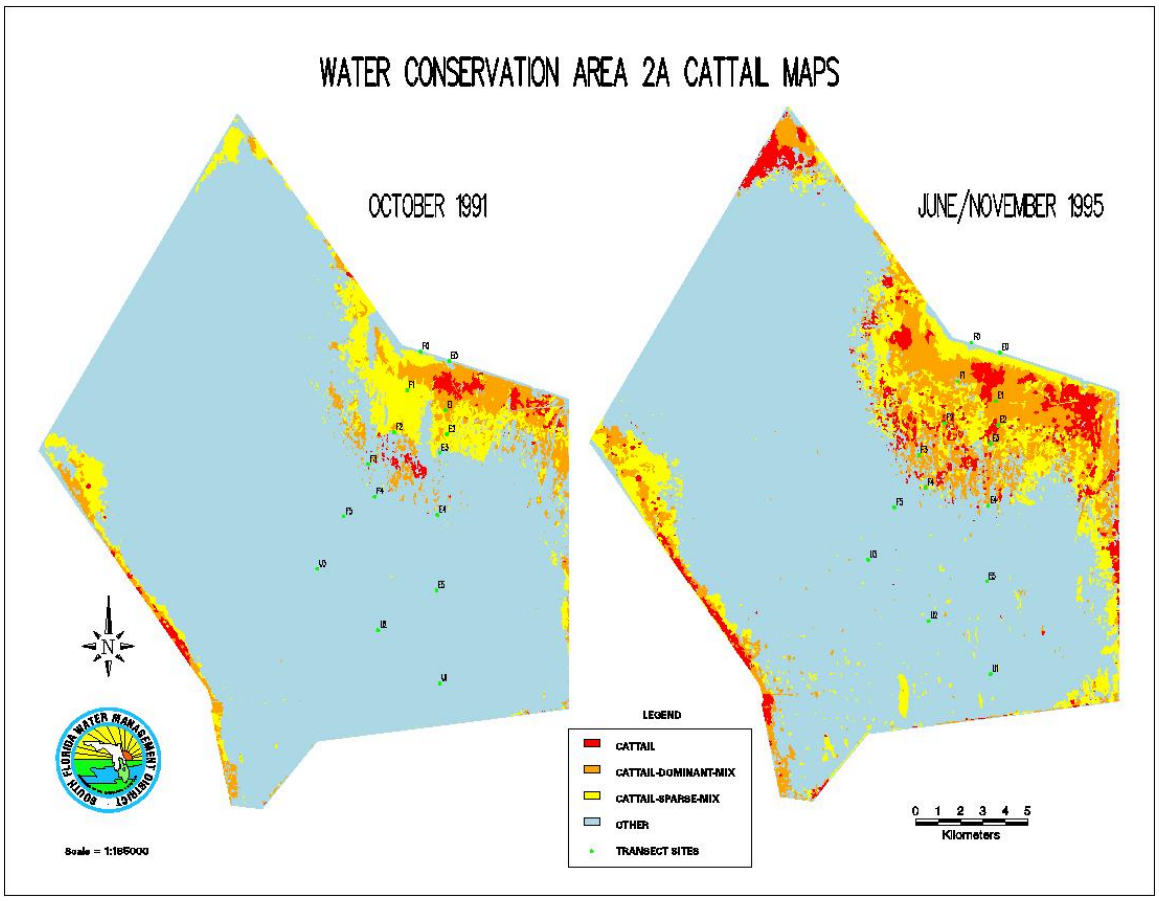


Figure 7b-2-12. Increase in cattail expanse in WCA 2A from 1991 to 1995 (Rutchey and Vilchek, 1999).

INDICATOR GRADE

NEED THIS INFORMATION

RESTORATION ACTION

Best management practices (BMPs) for "water year 2001" (May 2000–April 2001) resulted in an estimated 73 percent phosphorus load reduction to the Everglades. During this water year, 53 metric tons of phosphorus flowed out of the Everglades Agricultural Area basin (including farms, towns and industry), compared to the estimated 195 metric tons predicted to have been in the runoff had the BMPs not been implemented. Phosphorus concentrations in the water were also down, averaging 64 parts per billion (ppb) compared to pre-BMP concentrations of 173 ppb. Four Stormwater Treatment Areas (STAs), STA-1W, STA-2, STA-5 and STA-6, have been built and are operational, producing average discharge concentrations ranging from 20 to 30 ppb. As part of the process of establishing the water quality standard for surface water total phosphorus concentrations, a series of public workshops are currently being developed by the Florida Department of Environmental Protection. Draft reports suggest this standard will be 10 ppb.

WATER SUPPLY FOR SOUTH FLORIDA

COMPREHENSIVE PLAN TARGET

The Comprehensive Plan is designed to ensure South Florida's permitted water users will have at least a 1-in-10 year level of service from the regional water system. During a 1-in-10 year drought event (usually defined by lack of rainfall), the regional water available from Lake Okeechobee and the water conservation areas is expected to supplement local water supplies. For years when the lack of rain is greater than a 1-in-10 year event, local water supplies may need to be restricted to ensure an adequate supply through the end of the drought. Restrictions may not be necessary if local water suppliers have developed alternative sources.

SIGNIFICANCE AND BACKGROUND

Significantly less water flows through the ecosystem today compared to historical times. In fact, on average, 1.7 billion gallons of water that once flowed through the system are wasted each day through discharges to the Atlantic Ocean and the Gulf of Mexico. The Comprehensive Plan will capture most of this excess water in surface and underground storage areas where it will be stored until it is needed. The features proposed in the Comprehensive Plan will vastly increase the amount of water storage available in South Florida. As water storage increases and seepage losses decrease, losses to tide will decrease and the amount of regional water available will increase. This stored water will help meet a 1-in-10 year level of service. This is the long-term planning goal for meeting future water supplies that the state's water management districts use for regional water supply plans.

RECENT STATUS AND TRENDS

South Florida has had the driest 18 month period on record from November 1999 to April 2001. Most of South Florida has been under water shortage restrictions since December 2000. Under the restrictions imposed in 2001, public water demands decreased between 7 to 19 percent compared to 2000 withdrawals for the same month. Irrigation water deliveries from Lake Okeechobee to Everglades Agricultural Areas were reduced by about 40 percent compared to demands (**Figure 1**).

INDICATOR GRADE

RESTORATION ACTION

Long-term restoration will be achieved by the implementation of surface water storage reservoirs, seepage management, and aquifer storage and recovery projects recommended in the Comprehensive Plan. The water made available by these projects will offset demands or regional water from Lake Okeechobee and the water conservation areas.

The three regional water supply plans approved by the South Florida Water Management District in 2000 recommended projects that would increase water supply in the interim before the

Comprehensive Plan can be fully implemented. The plans include the development of alternative sources of water supply by applying reuse and reverse osmosis; increasing the efficiency of water storage in local drainage systems; increasing conservation programs; and developing rules for reservations, consumptive use permits, and minimum flows and levels. The regional water supply plans have a planning horizon of 20 years ending in 2020. Updates are prepared every 5 years.

For immediate relief, the SFWMD adopted a Water Supply Contingency Plan. It provides 25 options that can be implemented by the SFWMD and, in some cases in conjunction with local utilities, to augment water availability. Some of the options were recommended in the regional water supply plan, but could be expedited as part of the contingency plan.

LITERATURE CITED

DeBusk, W.F., S. Newman, and K.R. Reddy. 2001. Spatio-temporal patterns of soil phosphorus enrichment in Everglades Water Conservation Area 2A. *J. Environ. Qual.* 30: 1438-1446.

Chamberlain, R.H., and P.H. Doering. 1998. Preliminary estimate of optimum freshwater inflow to the Caloosahatchee Estuary: a resource-based approach. In: Treat, S.F. (ed.), *Proceedings of the Charlotte Harbor Public Conference and Technical Symposium, March 15-16, 1997*, Technical Report No. 98-02, Charlotte Harbor National Estuary Program, Punta Gorda, FL, pages 121-130.

Newman, S., K.R. Reddy, W.F. DeBusk, Y. Wang, G. Shih, and M.M. Fisher. 1997. Spatial distribution of soil nutrients in a northern Everglades marsh: Water Conservation Area 1. *Soil Sci. Soc. Am. J.* 61(4):1275-1283.

Reddy, K.R., W.F. DeBusk, Y. Wang, and M. Koch. 1991. *Physico-Chemical Properties of Soils in the Water Conservation Area 2 of the Everglades*. Gainesville, FL, University of Florida.

Reddy, K.R., Y. Wang, W.F. DeBusk, and S. Newman. 1994. *Physico-Chemical Properties of Soils in the Water Conservation Area 3 (WCA-3) of the Everglades*. Contract C90-1168, South Florida Water Management District, West Palm Beach, FL.

Rutchey, K., and L. Vilchek, 1999. Air photo-interpretation and satellite imagery analysis techniques for mapping cattail coverage in a northern Everglades impoundment. *Journal of Photogrammetric Engineering and Remote Sensing* 65(2):185-191.

RECOVER. 2000. *Base Line Report for the Comprehensive Everglades Restoration Plan 1999*. RECOVER, South Florida Water Management District, West Palm Beach, FL.

USEPA. 1999. *Regional Environmental Monitoring and Assessment Program*. South Florida Ecosystem Assessment Project, Region IV, United States Environmental Protection Agency, Athens, GA.